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ABSTRACT

This study examines the development, implementation, and early results of the Partnership to Involve the Scientific Community in Elementary Schools (PISCES) program. The PISCES project is a comprehensive approach to professional development utilizing university science graduate students, university and community scientists, and educators to enhance elementary science. The project is designed to address the constraints of quality elementary science instruction as identified in the research literature and by local classroom teachers through quality, long-term professional development. This report includes initial findings related to the professional development teachers' confidence level, improvement of communication skills, and future plans of the project. (KHR)

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UNIVERSITY SCIENCE MAJORS IN COLLABORATIVE PARTNERSHIPS WITH ELEMENTARY TEACHERS: INQUIRY BASED TEACHING AND LEARNING

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The Crisis in Elementary School Science

Unfortunately, the current state of elementary science education remains bleak. Science instruction continues to remain a low priority in elementary schools in the United States, particularly in California. Many teachers hesitate to incorporate science into the curriculum because they lack confidence in their ability to teach science. This is due, in part, to their own lack of science content knowledge (Wenner, 1993). Most teachers have taken several college-level courses, but these classes are typically lecture-based and do not prepare teachers to synthesize and teach science in a developmentally appropriate manner (McLoughlin & Dana, 1999). Even in instances when teachers are excited about including science in the curriculum, there are constraints to teaching elementary science. These constraints include lack of time, facilities, supplies and equipment (Abel & Roth, 1992). In addition, when science is taught, teachers frequently avoid hands-on lessons because these activities are deemed to be too much work, too time intensive, and too dependent on materials that are usually in short supply or lacking (Sumrall, 1997).

Many attempts have been made to improve elementary science instruction. One of the most promising is the redevelopment of undergraduate science courses to align with the

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National Science Education Standards (NCR, 1996) and to blend pedagogical content knowledge within content courses (Mason, 1999; McLoughlin & Dana, 1999). Unfortunately, it is unlikely this will become the norm any time soon.

Effective Professional Development

As we anticipate and explore long-term changes in science teaching for future teachers, effective professional development for practicing teachers needs to be developed and implemented. Haney and Lumpe (1995) argue that science education does not have a comprehensive framework for teacher professional development. Their recommendations include long-term training, fostering active teaching and learning, emphasizing science in the elementary grades, and providing context-specific training (Haney & Lumpe, 1995). These suggestions are supported by Loucks-Horsley (1998) who also identifies the importance of including science content in professional development. Currently, professional development programs for teachers in science education tend to be short-term, emphasize science for upper grades, and are not context-specific.

PISCES Project

This study examines the development, implementation, and early results of the Partnerships to Involve the Scientific Community in Elementary Schools (PISCES) program. The PISCES project is a comprehensive approach to professional development, utilizing university science graduate students, university and community scientists, and educators to

enhance elementary science. The PISCES project is designed to address the constraints to quality elementary science instruction, as identified in the research literature and by local classroom teachers, through quality, long-term professional development.

A needs assessment was conducted prior to implementation of the PISCES project. One hundred and four local teachers and nine administrators responded. Over half of the teachers reported teaching science two hours or less per week. Seventy-five teachers agreed or strongly agreed they would like someone knowledgeable about science to assist them in their teaching. Nearly 80% of the teachers indicated they would like to know strategies for integrating science with other disciplines, especially with the major focus on literacy and mathematics instruction. The top three needs identified were science instructional support, alignment with content standards, and science content training. The PISCES project was designed to help meet these needs.

PISCES Science Students

One of the primary goals of the project is to place people who have strong science content knowledge into elementary classrooms on a long-term basis to provide instructional support to the classroom teachers. The PISCES project, funded by NSF and local sources, provides fellowship support to graduate and upper-level undergraduate science students from several local universities to work in elementary classrooms. These science students, known as PISCES Science Corps Members, provide content knowledge and classroom assistance as they work with the teachers. Corps Members are placed in two elementary classrooms during each

eight-week cycle throughout the academic year. Their 15-20 hours of work each week focus on planning and presenting hands-on science lessons with the classroom teachers. Science Corps Members complete bi-weekly reports, weekly journals, yearly interviews, and meet with a faculty member weekly. During the 1999-2000 academic year, there were 11 students supported. The project was expanded to 20 students for the 2000-2001 academic year.

PISCES Professional Development

The PISCES project provides professional development to the Science Corps through a university seminar to prepare and support them. The seminar is designed to socialize Corps Members to the culture of the elementary school, provide them with a background for addressing the National Science Education Standards (NRC, 1996) and the inquiry approach to science, offer a forum for discussing pedagogical theory and strategies, and prepare them to use popular curricula materials such as FOSS (Full Option Science System) and STC (Science and Technology for Children) kits.

In addition to the professional development offered to the Science Corps Members, there are workshops held several times a year for the classroom teachers to learn strategies and content for inquiry-based science instruction. These workshops include field trips that allow teachers to interact with local scientists conducting research. The strength of these workshops is that the Corps Members are also involved, so collaborative teams gain the same knowledge and experiences.

PISCES Resources and Materials

The PISCES Project provides FOSS and STC kits to the teachers for the duration of the unit. After the completion of a unit, the kit is returned and refurbished before being sent out to another teacher. Corps Members add to the kits by providing additional content and teaching resources through their own research on the science topics. This aspect of the project aims to relieve some of the logistical constraints identified in the study by Sumrall (1997).

The final component of the project is to develop science curricula and resources to incorporate current research by local scientists, who are working to better understand global change. Study sites are located in California, Mexico, and the northern slope of Alaska. Throughout the project, real-time data is available to elementary classes. A subset of the Science Corps travels to the study sites to conduct research and develop appropriate curricula, as well as work with local classroom teachers to incorporate it into the elementary classroom curriculum.

Initial Findings

Early results (n=36) demonstrate that the professional development has helped the teachers to be more confident in their knowledge of inquiry approaches to teaching, their ability to integrate science with other disciplines, and the effective use of hands-on materials. Teachers indicate high levels of satisfaction with the project and are eager to remain with the project during subsequent years. One of their recommendations was that the Corps Members extend their time in an individual classroom from two months to three. This was implemented during September, 2000. Elementary students expressed their satisfaction with the scientists in their journal entries and at school functions. Before beginning a journal entry on what she had learned about electricity, one elementary student wrote:

> "This might not be a very positive thing at the beginning of a piece of writing, but let me start this reflection by saying that I don't like science very much. So when you announced the PISCES project I didn't exactly jump for joy. But as the scientists started coming in, I realized that I had under-estimated science. In electricity, I've leaned a lot. Since I've never really liked science, I've never given myself a chance to really learn anything...."

Unanticipated results included the higher level of confidence that the teachers gained as they sought to defend science instruction to their administrators who questioned the use of time spent on science instruction when the state and district emphases are on literacy and mathematics.

The Science Corps Members also reported highly positive experiences. In interviews, fellows indicated that their communication skills had improved, they had a much better understanding of the rewards and challenges involved in teaching elementary school, their

college teaching (teaching assistantships) had changed to more closely resemble an inquiry approach, and some were considering careers in education, or at least including out-reach education in their future plans. One of the Corps stated, "I've learned a lot. I teach in a different manner, not the way I've been taught recently. I don't just stand up there and tell them.... I now want to teach high school. I've made a lot of contacts and I've also increased my content knowledge." Another Member found that "it makes you think about all of the little aspects of science. The parts you take for granted, now I've learned to put it all together." All of the Corps Members who have not graduated are planning to continue in the program.

Future Plans

The PISCES project has increased in size. There are now over 60 classroom teachers involved, 20 science Corps members, and more than 1,200 elementary students who have participated. Data collection continues, including interviews, surveys, journals, and classroom observations. The ultimate goal of the PISCES project is to increase quality science education in elementary schools after the Corps members have moved on to other schools. As the teachers become more comfortable with teaching science, they will begin to take the lead in the lessons, and finally, will teach the units without the PICSES Corps. In fact, we have already seen a spill-over to other classrooms as a result of the PISCES project. The project hopes to find that the support of materials, resources, content knowledge, assistance in the classroom, as well as the development of a community of teachers and scientists dedicated to excellence in science education will move teachers beyond the perceived constraints. Administrators,

science educators and local business and industry personnel are key to the institutionalization of such efforts.

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